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(54) Antiglare reflector for light sources.

(57) Optical reflector (1) for light sources having a portion of its reflecting surface behind the light source (2) which exhibits a profile of two circle involutes (2a, 2b) disposed symmetrically on either side of a vertical axis and intersecting at a prefixed distance from the source. The two involutes have each as generator circle the cross section of the source and their origins are on one side of the circle. The two involute profile portions merge with two profile portions appearing as parabola branches (4a, 4b) of which the axes are angled and convergent. The reflector is glare-free, combining maximum photometric efficiency with compact dimensions, and sheds light uniformly onto a work area beneath.

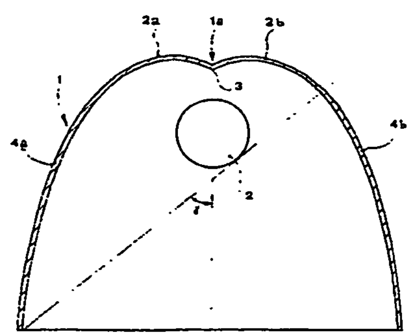

Fig.1

The present invention relates to a reflector for light sources, intended specifically though by no means exclusively for use with fluorescent tube appliances, and designed to reflect the light without producing glare.

Given the diversity of activities in any one office environment and the various items of informatics equipment now in widespread use (VDU terminals, plotters, printers, etc.), lighting appliances must also be diversified to ensure that personnel will not suffer undue discomfort. Accordingly, office lighting must contribute materially to the creation of comfortable visual conditions suited to each of the single tasks conducted at a given work station, while responding also to the need for economies in energy consumption.

A variety of factors are brought together in the creation of such visual comfort, among which two are of special interest, namely the control of glare and the degree to which illumination of desk tops or work surfaces can be rendered uniform.

Discounting the effect of natural light, the main causes of glare are attributable to the emission characteristichs of ligthing appliances. The most effective method of overcoming glare is to design appliances with the following specifications:

- luminous emissions are concentrated mainly between 25° and 45° from the vertical;
- the intensity of luminances at 50° and more from the vertical are no greater than 200cd/m^2.

Lighting appliances of this type are known commonly as "dark light" or "BAP 50°", and use conventional tubular fluorescent lamps.

A further requirement not met in appliances of the aforementioned type, is that luminances between +25° and -25° should ensure a uniform illumination of the work surface.

According to the actual art, glare is overcome by the adoption of exacting optical specifications and throught the use of special diffusers, though at the expense of luminous efficency, much of which is sacrificed in optimizing the antiglare geometry of the reflector; in effect, parameters favourable in this respect are not favourable in terms of luminous efficiency, and viceversa. Moreover, antiglare reflectors of the type in question are often bulky.

A typical fluorescent tube reflector that generates no transverse glare, i.e. in a plane normal to the longitudinal axis of the tubular light source, appears generally as a trough with two concave surfaces disposed symmetrically in relation to the longitudinal axis aforementioned and intersecting along a line parallel to this same axis. Thus, the cross sectional profile of the reflector exhibits a cusp located directly behind the tube. With this type of geometry, the light rays emitted from the source are radiated from the appliance, whether directly or reflected, within a prescribed angle γ known as the cut-off or masking angle (see fig. 1).

A certain proportion of emitted light is reflected back into the source however, resulting in a loss of optical efficiency, i.e. the ratio of luminous flux emitted by the appliance to the luminous flux from the bare tube, without any masking medium.

Moreover, the need to minimize reflection back onto the lamp signifies that generous concave surfaces are required at the back of the tube; this results in elongation of the cusped profile on either side and, in consequence, considerably increased overall dimensions of the antiglare reflector when compared to those of an ordinary reflector.

Accordingly, the object of the present invention is to improve the optical efficiency of a conventional antiglare light source reflector, while noticeably reducing the dimensions of such a reflector.

A further object of the invention is to provide an antiglare reflector capable of throwing uniform illumination onto a work surface beneath.

The stated objects are realized in a reflector according to the present invention, which exhibits a transverse profile comprising a cusp located behind the light source, and is characterized in that the cusp is created by the intersection of two portions of said profile developping as two symmetrically disposed circle involutes, the circle generating each of them being the cross section of the light source, said involutes having their origins on opposite sides of said cross section, and in that said involute profile portions merge on either flank of the light source with corresponding profile portions developping as parabola branches of which the axes are angled and convergent.

According to the invention, the luminous emissions from the parabolic portions are concentrated around an angle of 30° from the vertical, whilst the two involute profile portions serve to recover luminous energy directed from the light source to the rear of the appliance, thereby maximizing the efficiency of the appliance, and ensuring uniform illumination of a desk top or work surface on which light is shed by the appliance.

Further characteristics and advantages of the optical reflector according to the invention will be appar nt from the following description of an exemplifying and not limiting embodiment made with refer nce the accompanying drawings, in which:

- fig. 1 is a cross section through a reflector according to the invention;
- fig. 2 shows the characteristic photometric curve of a reflector according to the invention.

With reference to fig. 1 of the drawings, 1 generally denotes a reflector, viewed in cross section, by which a tubular light source 2 is accommodated. The hood or vault 1a of the reflector 1 is embodied as two concave surfaces disposed symmetrically on either side of a vertical plane passing through the longitudinal axis of the light source 2. The concave surfaces intersect in correspondance of said vertical plane along a line parallel with the axis. According to the invention, these concave surfaces appear in section as two circle involutes 2a and 2b, of which the mutual intersection produces a cusp 3 located directly behind the tube 2. Whilst the circle from which the two involute curves are generated is one and the same as that presented by the tube 2 in cross section, the respective origins are located to either side of the longitudinal axis so that, in practice, the cusp 3 remains spaced apart from the tube.

The two concave surfaces 2a and 2b with circle involute profile merge at the ends opposite to the intersection 3 with further parabolic surfaces appearing in cross section as two parabola branches 4a and 4b of which the axes are oblique and converge in front of the tube. More exactly, the point at which the parabolic and involute profiles merge is selected in such a way that a cut-off angle γ of 45° - 65° will be established between the vertical plane and a straight line tangential to the front of the tube and passing through the point of mergence. In a preferred embodiment of the invention, the cut-off angle would be 50°, as a narrower angle signifies lower efficiency and a deeper reflector, and with a wider angle, glare is progressively increased; this much said, $\gamma = 60^\circ$ can be acceptable in a lighting appliance for less demanding applications. Likewise according to the invention, the inclination α of the parabola axes associated with the branches 4a and 4b, relative to the vertical, must be such that $\gamma/2 \leq \alpha < \gamma$. In a preferred appliance, where $\gamma = 50^\circ$, the value of α will be 35°, such that the light reflected from the two parabola branches is shed at $\pm 30^\circ$ approximately from the vertical.

The distance separating the mouth of the reflector from the tube will be established automatically once the cut-off angle γ and the angle α of inclination of the parabolas are defined. In effect, each parabolic curve 4a and 4b terminates on intersecting the straight line tangential to the tube 2, angled γ or $-\gamma$ from the vertical, which passes through the merging point of the parabolic curve and involute curve on the opposite flank of the profile. In this way, clearly, no part of the light source can be sighted directly by an observ r viewing from outside the cut-off angle.

The distance separating the cusp 3 from the tube 2 is determined by the diameter of the tube itself, and, in particular, is comprised between 20 and 60% of that diameter. In a preferred embodiment, the distance will be 40 ÷ 50% of the tube diameter, as observation has shown that percentages above and below tend to give a poorer illumination, concentrated respectively toward the sides and into the centre of the area on which the light is shed.

In practical application, it has been found that with a 26 mm diameter tube, the optimum distance for the cusp is 12mm; this gives less than 10% variations in illumination, which are imperceptible.

Having thus established the parameters in question which univocally define the two involute curves 2a and 2b and the two parabolic curves 4a and 4b, a nominal optical efficiency of 100% is achieved with ideal reflectivity of the material used. Moreover, both the selection of the involute profile and the angled position of the parabola axes combine to reduce the dimensions of the reflector according to the invention, when compared to other conventional reflectors. In particular, the parabola axes are plotted at the maximum angle compatible with the requirement for avoiding reflection back into the light source from the parabolic portion of the profile. It will be clear enough, in effect, that whilst a wider angle of the parabola axes gives greater compactness in both width and depth of the reflector, light will begin to reflect back onto the light source beyond a certain angle, the result of which is lost efficiency.

By way of example, a comparison is given between the dimensions of a reflector according to the invention (reflector A) and those of a reflector on general sale (reflector B) affording equivalent performance in terms of glarefree illumination.

	REFLECTOR	
	A	B
width, mm	130	190
depth, mm	100	170

The reflector selected for comparison purposes, manufactured by Daume & Jordan of Germany, exhibits the typical cusped section with symmetrical twin concave surfaces, though with a profile different to that of the reflector according the present invention.

Fig. 2 shows the photometric luminous intensity curve of a reflector according to the invention, and in particular of a prototype in which $\gamma = 50^\circ$, $\alpha = 35^\circ$ and the cusp 3 is separated from a light source of 26mm diameter by a distance of 12mm. Evidence is given of the uniform light shed by such a reflector onto a desk top or work surface beneath, which is a fundamental requirement in providing a proper, visually comfortable illumination of the surface. The concave part of the curve covering $\pm$ 25 $\div$ 30° may be expressed approximately by the equation

$$I_\theta = Io/\cos^3\theta$$

where Io is luminous intensity along the vertical axis. Maximum emission free of glare, whether direct or reflected, occurs in the $\pm$ 25 $\div$ 45° bands.

Whilst reference is made predominantly to a tubular type lamp in the foregoing description, hence to a reflector of essentially semicylindrical shape, it will be clear enough that a 360° revolution of the same mixed profile about an axis passing through the cusp 3 will produce a dished or domed reflector similarly suitable for spherical light sources.

It will be equally clear from the foregoing that the photometric curve of a reflector according to the invention can be designed and modified to suit a variety of illumination requirements, civil and industrial alike, simply by altering the relative geometrical parameters (angles and distances), with the essential construction features (involute and parabola) remaining unaltered.

Variation and/or modification can be brought to the reflector for light sources according to the present invention, without departing from the scope of the invention itself.

Claims

1. A reflector for light sources, exhibiting a cross sectional profile comprising a cusp located behind the light source, characterized in that the cusp (3) is created by the intersection of two portions (2a, 2b) of said profile developping as two symmetrically disposed circle involutes, the circle generating each of them being the cross section of the light source (2), said involutes having their origins on opposite sides of said cross section, and in that said involute profile portions merge on either flank of the light source with corresponding profile portions (4a, 4b) developping as parabola branches of which the axes are angled and convergent.

2. A reflector according to the claim 1, wherein the points at which the involutes merge with the parabolic curves are located on two straight lines tangential to the cross section of the light source (2) and disposed at a cut-off angle γ comprised between 45° and 65° from vertical.

3. A reflector according to the claim 2, wherein said straight lines are angled 50° from vertical.

4. A reflector according to the previous claims, wherein the cusp (3) is separated from the light source (2) by a distance equivalent to 20 $\div$ 60% of the diameter of the light source.

5. A reflector according to the claim 4, wherein the cusp and light source are separated by a distance equivalent to 40 - 50% of the diameter of the light source.

6. A reflector according to the claim 5 utilized in conjunction with a light source od diameter 26mm, wherein the cusp is separated from the light source by a distance of 12mm.

7. A reflector according to the previous claims, wherein the angle of inclination α of the axes of said parabola branches from the vertical is such that:

$$\gamma/2 \leq \alpha < \gamma$$

8. A reflector according to the claim 7, exhibiting a cut-off angle γ of 50°, wherein the angle α of the

parabola axis is ± 35°.

9. A reflector according to the previous claims, wherein said parabola branches (4a, 4b) extend from the points of mergence with the respective involutes (2a, 2b) to points of intersection with the straight lines disposed tangential to the cross section of the light source (2) and having an inclination angle equal to $\pm\gamma$.

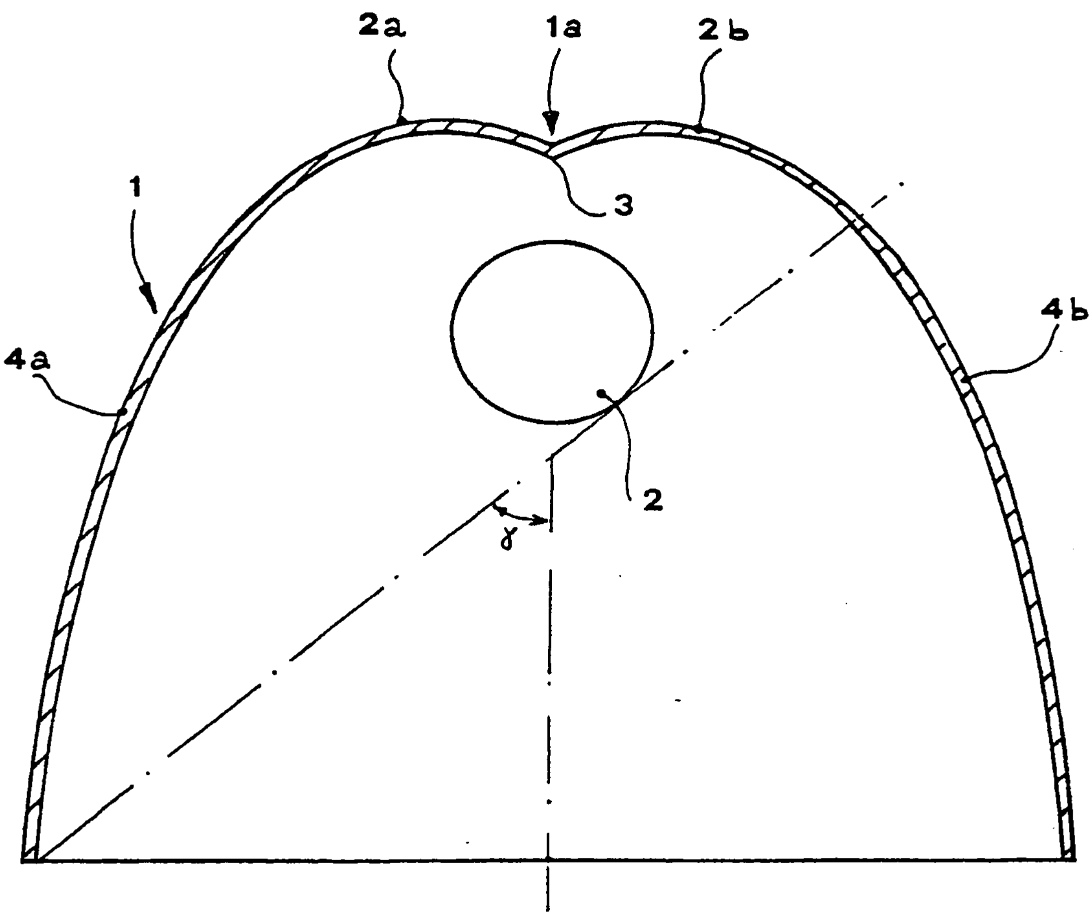

Fig.1

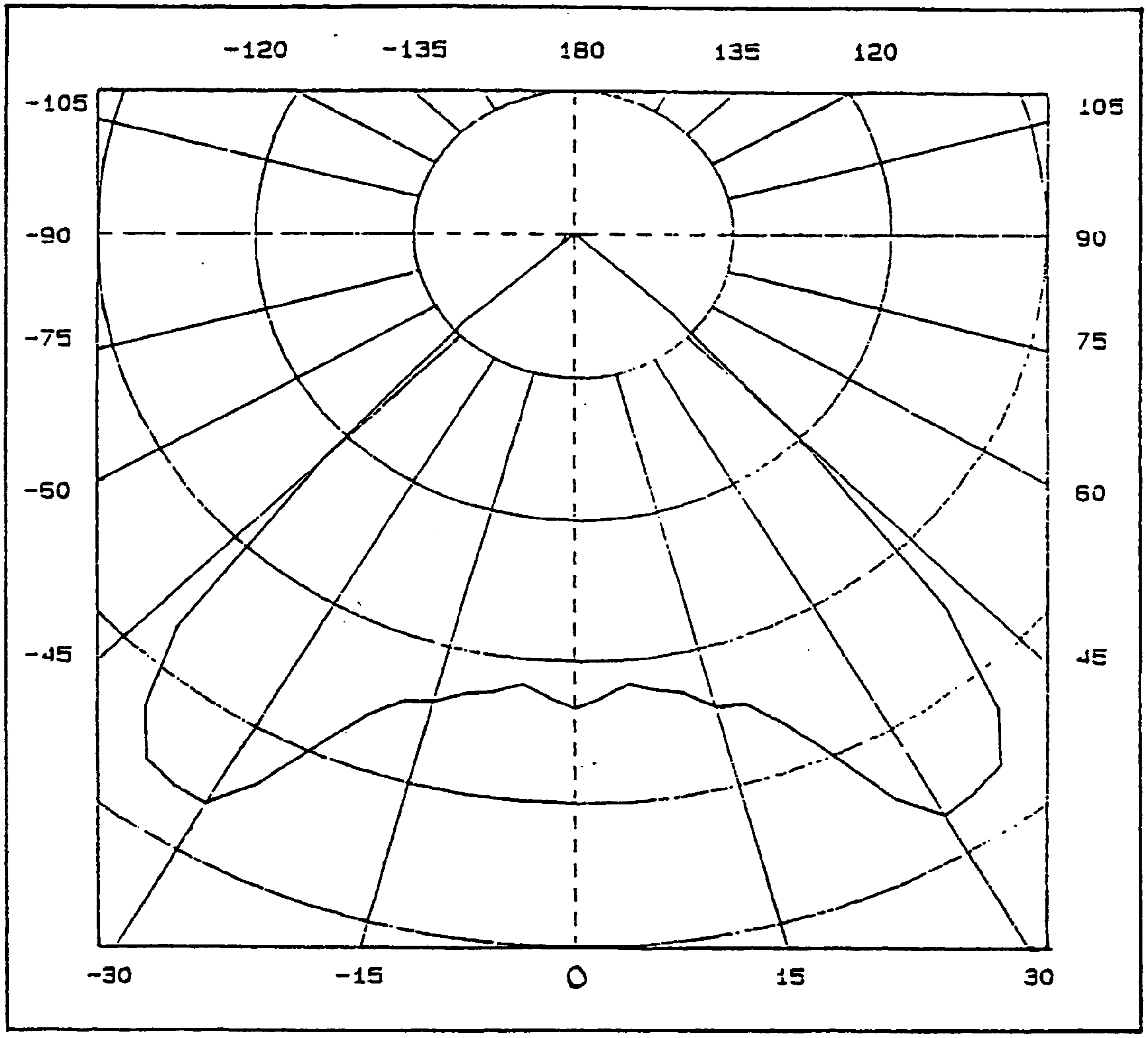

Fig.2

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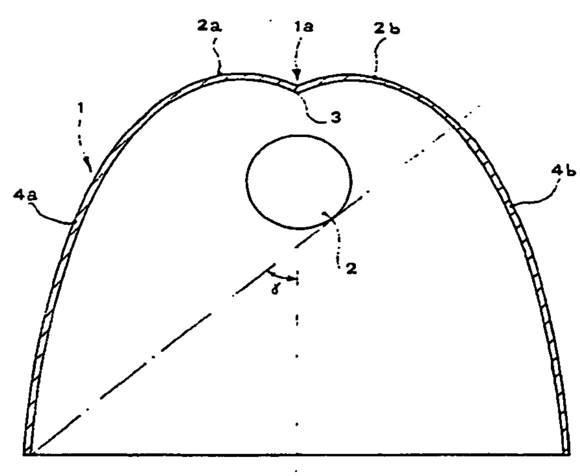

Fig.1

EP 0 442 246 A3

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EUROPEAN SEARCH REPORT

Application Number

EP 90 83 0346

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Y	DE-A-2 755 253 (POULSEN) * Figures 1,6; claims 1,2,4,7; page 11, lines 29-35; pages 12,13 *	1,2,9	F 21 V 7/12
A		4,5,7	
	– – –		
Y	EP-A-0 008 006 (SIEMENS AG) * Figure 1; claims 1,3; page 5, lines 4-25 *	1,2,9	
A		3	
	– – –		
A	GB-A-8 840 68 (NIELAND) * Page 2, column 1, lines 59-65; figures 1,2 *	1	
	– – – – –		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

F 21 V
F 21 K
G 02 B

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	11 July 91	DE MAS A.G.

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
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